



# Technical Report Series on the Biosystem-Air Atmosphere Study (BOREAS)

*William J. Shuttleworth and Sara Conrad, Editors*

**199**

**SSA TF-4 CO<sub>2</sub> and CH<sub>4</sub>  
Fluxes from the SSA**

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## **Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)**

*Forrest G. Hall and Sara Conrad, Editors*

### **Volume 199**

## **BOREAS TF-4 CO<sub>2</sub> and CH<sub>4</sub> Soil Profile Data from the SSA**

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# **BOREAS TF-4 CO<sub>2</sub> and CH<sub>4</sub> Soil Profile Data from the SSA**

Rob Striegl, Kimberly P. Wickland

## **Summary**

The BOREAS TF-4 team measured distributions of carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>) concentrations for the upper 5 m of soil and unsaturated zone at the mature stand, upper 6 m at the 20-year-old stand, and the upper 1 m at the 8-year-old stand and clear cut area at the BOREAS SSA during August 1993 to March 1995. Particle size and carbon content of the unsaturated deposits, precipitation, soil temperature and moisture, carbon and oxygen isotopes of soil CO<sub>2</sub>, and soil water chemistry are also presented. The data are stored in tabular ASCII files.

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## **1. Data Set Overview**

### **1.1 Data Set Identification**

BOREAS TF-04 CO<sub>2</sub> and CH<sub>4</sub> Soil Profile Data from the SSA

### **1.2 Data Set Introduction**

Data presented in this document were collected at the Old Jack Pine (OJP) and Young Jack Pine (YJP) tower flux sites and nearby clear cut areas at the BOREal Ecosystem-Atmosphere Study (BOREAS) Southern Study Area (SSA). The BOREAS Tower Flux (TF)-04 team measured distributions of carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>) concentrations for the upper 5 m of soil and unsaturated zone at the mature stand, upper 6 m at the 20-year-old stand, and the upper 1 m at the 8-year-old stand and clear cut area at the SSA during August 1993 to March 1995. Particle size and carbon content of the unsaturated deposits, precipitation, soil temperature and moisture, carbon and oxygen isotopes of soil CO<sub>2</sub>, and soil water chemistry are also presented. The data are stored in tabular American Standard Code for Information Interchange (ASCII) files.

### **1.3 Objective/Purpose**

This study presents data relevant to understanding the transfer and storage of carbon among soil, the unsaturated zone, ground cover vegetation, and understory air in jack pine forest at the SSA. The data were collected continuously from May through September 1994 and during March 1995.

### **1.4 Summary of Parameters**

The primary focus is on the net concentrations of soil CO<sub>2</sub> and CH<sub>4</sub> measured.

### **1.5 Discussion**

Jack pine woodlands are an important component of the boreal forest, covering more than  $2 \times 10^{12}$  m<sup>2</sup> of predominantly well-drained uplands in northern North America. As part of BOREAS, our study objectives were (1) to compare soil respiration at an undisturbed 65- to 90-year-old mature jack pine-lichen woodland with soil respiration at a formerly continuous portion of the stand that was clear-cut harvested during the previous winter, and (2) to identify and quantify the sources of CO<sub>2</sub> and CH<sub>4</sub> production within the soil profile.

### **1.6 Related Data Sets**

BOREAS TGB-01/TGB-03 CH<sub>4</sub> Chamber Flux Data over the NSA Fen  
BOREAS TGB-03 Plant Species Composition Data over the NSA Fen  
BOREAS TGB-01/TGB-03 NEE Data over the NSA Fen  
BOREAS TGB-03 CH<sub>4</sub> and CO<sub>2</sub> Chamber Flux Data over NSA Upland Sites  
BOREAS TGB-01 NSA CH<sub>4</sub> and CO<sub>2</sub> Chamber Flux Data  
BOREAS TGB-01 CH<sub>4</sub> Concentration and Flux Data from NSA Tower Sites  
BOREAS TGB-01 NSA SF<sub>6</sub> Chamber Flux Data

## **2. Investigator(s)**

### **2.1 Investigator(s) Name and Title**

Dr. Rob Striegl  
Hydrologist  
United States Geological Survey

Dr. Kimberly Wickland  
United States Geological Survey

### **2.2 Title of Investigation**

Measurements of Soil Carbon Dioxide and Methane Concentrations and Fluxes, and Soil Properties at Four Ages of Jack Pine Forest in the Southern Study Area of the Boreal Ecosystem Atmosphere Study, Saskatchewan, Canada, 1993-95

### **2.3 Contact Information**

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### **3. Theory of Measurements**

Atmospheric chemistry measurements and modeling studies identify a global imbalance between known CO<sub>2</sub> production and uptake, with a potentially large terrestrial carbon sink possible in boreal forests. Northern woodlands are also perceived to be very sensitive to climate change. The predicted warming and drying of the boreal region could profoundly affect regional carbon sources and sinks. Carbon cycling of the boreal forest has consequently been a central theme of much recent field research. With the intent of eventually extrapolating land-based carbon, energy, and water flux measurements to the entire boreal forest biome, BOREAS subdivided the northern and southern sections of Canadian boreal forest into aspen, jack pine, and bog-fen landscapes for intensive study. Studies within these vegetation types focused on a variety of factors that influence carbon cycling, including forest stand age and land surface disturbances (Sellers et al., 1995).

Soil respiration, the second largest flux in the global carbon cycle, includes all CO<sub>2</sub> produced by roots, soil organisms, and oxidation that is emitted across the soil-air interface. Although globally important, soil respiration is not well characterized spatially or seasonally for most ecosystems.

### **4. Equipment**

#### **4.1 Sensor/Instrument Description**

##### **4.1.1 Collection Environment**

Data were collected under all environmental conditions.

##### **4.1.2 Source/Platform**

Ground.

##### **4.1.3 Source/Platform Mission Objectives**

Support investigators and soil probes.

##### **4.1.4 Key Variables**

CO<sub>2</sub> and CH<sub>4</sub> concentrations.

#### **4.1.5 Principles of Operation**

Soil surface temperature was measured using a Fluke model 51 K thermometer at three depths (0.05, 0.10, and 0.15 m) at each pair of chambers in conjunction with flux measurements.

Soil water content was determined from soil samples collected at each pair of chambers concurrent with flux measurements. Each sample included the top 0.05 m of soil and was sealed in an air-tight container until analysis. The samples were weighed, oven-dried at 105 °C for approximately 24 hours, and weighed again. After subtracting the container weight, percent water content was calculated as the difference of the original sample weight and the dried sample weight divided by the original sample weight and multiplied by 100 (Klute, 1986).

Concentrations CO<sub>2</sub> and CH<sub>4</sub> in soil gas were measured at chamber pairs at each of the four transects using 2.0-mm inside diameter stainless steel probes. The probes were inserted to soil depths ranging from 0.02 m to 0.50 m, and soil gas was collected using nylon syringes. CO<sub>2</sub> concentration was analyzed onsite using a PP Systems model EGM infrared gas analyzer (IRGA), and CH<sub>4</sub> concentration was analyzed by gas chromatography using methods described above. Soil gas collection was concurrent with chamber measurements.

In addition to the chamber pair probe measurements, each site had a series of permanent probes installed for soil gas collection. The OJP site had permanent probes installed within 10 m of the first chamber pair (GH) to a maximum depth of 3.4 m. The YJP site had permanent probes installed within 10 m of the first chamber pair (AB) to a maximum depth of 6.0 m. Additional probes were located 5 m south of the YJP instrument shelter.

Soil gas was collected from three series of depths in the unsaturated zone at YJP. CO<sub>2</sub>, extracted from the gas by cryogenic trapping, was analyzed for <sup>13</sup>C and <sup>18</sup>O content using mass spectrometry at the U.S. Geological Survey gas isotope laboratory in Denver, CO. Values were obtained from samples collected on one occasion. Stable isotope values are presented in delta notation in units of the parts per thousand relative difference (permil) between the ratios of <sup>13</sup>C to <sup>12</sup>C and <sup>18</sup>O to <sup>16</sup>O in the samples and Pee Dee belemnite for <sup>13</sup>C and Standard Mean Ocean Water for <sup>18</sup>O.

Gravity drainage lysimeters were installed at the YJP and OJP sites to collect liquid water percolating through the unsaturated sands to a maximum depth of 1.00 m. Only one rainfall event (day 200, 1994) was large enough to initiate sufficient percolation at the YJP site for water sample collection and analysis. Sufficient water volume was never collected at the OJP site.

#### **4.1.6 Sensor/Instrument Measurement Geometry**

Not applicable.

#### **4.1.7 Manufacturer of Sensor/Instrument**

Concentrations CO<sub>2</sub> and CH<sub>4</sub> in soil gas were measured at chamber pairs at each of the four transects using 2.0-mm inside diameter stainless steel probes. The probes were inserted to soil depths ranging from 0.02 m to 0.50 m, and soil gas was collected using nylon syringes.

- PP Systems model EGM IRGA
- Fluke model 51 K thermometer

### **4.2 Calibration**

#### **4.2.1 Specifications**

None given.

##### **4.2.1.1 Tolerance**

None given.

#### **4.2.2 Frequency of Calibration**

Traceable gas calibration standards for all CO<sub>2</sub> and CH<sub>4</sub> analyses were provided by BOREAS operations.



#### **4.2.3 Other Calibration Information**

None given.

### **5. Data Acquisition Methods**

Soil surface temperature was measured using a Fluke model 51 K thermometer at three depths (0.05, 0.10, and 0.15 m) at each pair of chambers in conjunction with flux measurements.

Soil water content was determined from soil samples collected at each pair of chambers concurrent with flux measurements. Each sample included the top 0.05 m of soil and was sealed in an air-tight container until analysis. The samples were weighed, oven-dried at 105 °C for approximately 24 hours, and weighed again. After subtracting the container weight, percent water content was calculated as the difference of the original sample weight and the dried sample weight divided by the original sample weight and multiplied by 100 (Klute, 1986).

Concentrations CO<sub>2</sub> and CH<sub>4</sub> in soil gas were measured at chamber pairs at each of the four transects using 2.0-mm inside diameter stainless steel probes. The probes were inserted to soil depths ranging from 0.02 m to 0.50 m, and soil gas was collected using nylon syringes. CO<sub>2</sub> concentration was analyzed onsite using a PP Systems model EGM IRGA, and CH<sub>4</sub> concentration was analyzed by gas chromatography using methods described above. Soil gas collection was concurrent with chamber measurements.

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Gravity drainage lysimeters were installed at the YJP and OJP sites to collect liquid water percolating through the unsaturated sands to a maximum depth of 1.00 m. Only one rainfall event (day 200, 1994) was large enough to initiate sufficient percolation at the YJP site for water sample collection and analysis. Sufficient water volume was never collected at the OJP site.

### **6. Observations**

#### **6.1 Data Notes**

None given.

#### **6.2 Field Notes**

None given.

## 7. Data Description

### 7.1 Spatial Characteristics

#### 7.1.1 Spatial Coverage

The North American Datum of 1983 (NAD83) coordinates of the sites are:

SSA-OJP:	53.91634° N, 104.69203° W
SSA-YJP:	53.87581° N, 104.64529° W
Clear Cut (CC):	53.9090° N, 104.6595° W
Recent Cut (RC):	53.9091° N, 104.6671° W

#### 7.1.2 Spatial Coverage Map

Not available.

#### 7.1.3 Spatial Resolution

These are point measurements made at the given locations.

#### 7.1.4 Projection

Not applicable.

#### 7.1.5 Grid Description

Not applicable.

### 7.2 Temporal Characteristics

#### 7.2.1 Temporal Coverage

The data set covers the period from 26-May-1994 to 21-Mar-1995.

#### 7.2.2 Temporal Coverage Map

Not available.

#### 7.2.3 Temporal Resolution

Soil gas collection was concurrent with chamber measurements.

### 7.3 Data Characteristics

#### 7.3.1 Parameter/Variable

The parameters contained in the data files on the CD-ROM are:

##### TF04\_SOIL\_CARBON

Column Name

-----  
SITE\_NAME  
SUB\_SITE  
DATE\_OBS  
DEPTH\_INTERVAL  
TOTAL\_CARBON\_CONTENT  
INORGANIC\_CARBON\_CONTENT  
CRTFCN\_CODE  
REVISION\_DATE

**TF04\_SOIL\_CH4\_PROFILE**

Column Name

-----  
SITE\_NAME  
SUB\_SITE  
DATE\_OBS  
CHAMBER\_ID  
SOIL\_DEPTH  
CH4\_CONC  
REVISION\_DATE  
CRTFCN\_CODE

**TF04\_SOIL\_CO2\_ISOTOPE**

Column Name

-----  
SITE\_NAME  
SUB\_SITE  
DATE\_OBS  
CHAMBER\_ID  
SOIL\_DEPTH  
DEL\_13C  
DEL\_18O  
CO2\_CONC  
CRTFCN\_CODE  
REVISION\_DATE

**TF04\_SOIL\_CO2\_PROFILE**

Column Name

-----  
SITE\_NAME  
SUB\_SITE  
DATE\_OBS  
CHAMBER\_ID  
SOIL\_DEPTH  
CO2\_CONC  
REVISION\_DATE  
CRTFCN\_CODE

**TF04\_SOIL\_TEMP\_MOIST**

Column Name

-----  
SITE\_NAME  
SUB\_SITE  
DATE\_OBS  
TIME\_OBS  
CHAMBER\_ID  
AIR\_TEMP  
SOIL\_TEMP\_5CM  
SOIL\_TEMP\_10CM  
SOIL\_TEMP\_15CM  
SOIL\_WATER\_CONTENT  
CRTFCN\_CODE  
REVISION\_DATE

**TF04\_SOIL\_WATER\_CHEM**

Column Name

-----

SITE\_NAME  
 SUB\_SITE  
 DATE\_OBS  
 SOIL\_DEPTH  
 TOT\_ORG\_C\_CONC  
 TOT\_INORG\_C\_CONC  
 ACID\_NEUTRALIZING\_CAPACITY  
 ELECTRIC\_CONDUCTIVITY  
 SODIUM\_EQUIV  
 AMMONIUM\_EQUIV  
 POTASSIUM\_EQUIV  
 MAGNESIUM\_EQUIV  
 CALCIUM\_EQUIV  
 CHLORIDE\_EQUIV  
 NITRATE\_EQUIV  
 SULFATE\_EQUIV  
 CRTFCN\_CODE  
 REVISION\_DATE

**7.3.2 Variable Description/Definition**

The descriptions of the parameters contained in the data files on the CD-ROM are:

**TF04\_SOIL\_CARBON**

Column Name

Description

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS	The date on which the data were collected.
DEPTH_INTERVAL	The range of depths at which the soil carbon measurements were taken.
TOTAL_CARBON_CONTENT	The percent total carbon content by weight of the sample.
INORGANIC_CARBON_CONTENT	The percent inorganic carbon content by weight of the sample.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

**TF04\_SOIL\_CH4\_PROFILE**

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS in the format GGGGG-IIIIL, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIIL is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS	The date on which the data were collected.
CHAMBER_ID	Identifier assigned to the chamber measured
SOIL_DEPTH	The depth below the soil surface at which the measurement was taken.
CH4_CONC	CH4 concentration.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

**TF04\_SOIL\_CO2\_ISOTOPE**

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS in the format GGGGG-IIIIL, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIIL is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS	The date on which the data were collected.
CHAMBER_ID	Identifier assigned to the chamber measured
SOIL_DEPTH	The depth below the soil surface at which the measurement was taken.
DEL_13C	The del 13C is a relative difference between the sample and the PeeDee Belemnite standard, relative to the PeeDee Belemnite standard.
DEL_18O	The del 18O is a relative difference between the sample and the SMOW standard, relative to the SMOW standard.

CO2_CONC	CO2 concentration.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

#### TF04\_SOIL\_CO2\_PROFILE

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS	The date on which the data were collected.
CHAMBER_ID	Identifier assigned to the chamber measured
SOIL_DEPTH	The depth below the soil surface at which the measurement was taken.
CO2_CONC	CO2 concentration.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

#### TF04\_SOIL\_TEMP\_MOIST

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS	The date on which the data were collected.
TIME_OBS	The Greenwich Mean Time (GMT) when the data were

CHAMBER_ID	collected.
AIR_TEMP	Identifier assigned to the chamber measured
SOIL_TEMP_5CM	The air temperature.
SOIL_TEMP_10CM	Soil temperature measured at a depth of 5 cm.
SOIL_TEMP_15CM	Soil temperature at a depth of 10 cm.
SOIL_WATER_CONTENT	Soil temperature at a depth of 15 cm.
	The water content of the soil, measured at the top 0.05 meters of soil, reported in percent weight.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

#### TF04\_SOIL\_WATER\_CHEM

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS	The date on which the data were collected.
SOIL_DEPTH	The depth below the soil surface at which the measurement was taken.
TOT_ORG_C_CONC	The total organic carbon concentration in the soil water
TOT_INORG_C_CONC	Total inorganic carbon concentration in the soil water.
ACID_NEUTRALIZING_CAPACITY	The acid neutralizing capacity of the soil water.
ELECTRIC_CONDUCTIVITY	The electric conductivity of the soil sample.
SODIUM_EQUIV	Microequivalents of Sodium charge per liter of soil water
AMMONIUM_EQUIV	Microequivalents of Ammonium charge per liter of soil water
POTASSIUM_EQUIV	Microequivalents of Potassium charge per liter of soil water
MAGNESIUM_EQUIV	Microequivalents of magnesium charge per liter of soil water
CALCIUM_EQUIV	Microequivalents of calcium charge per liter of soil water
CHLORIDE_EQUIV	Microequivalents of chloride charge per liter of soil water
NITRATE_EQUIV	Microequivalents of nitrate charge per liter of

SULFATE_EQUIV	soil water Microequivalents of sulfate charge per liter of soil water
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

### 7.3.3 Unit of Measurement

The measurement units for the parameters contained in the data files on the CD-ROM are:

#### TF04\_SOIL\_CARBON

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
DEPTH_INTERVAL	[meters]
TOTAL_CARBON_CONTENT	[percent]
INORGANIC_CARBON_CONTENT	[percent]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

#### TF04\_SOIL\_CH4\_PROFILE

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
CHAMBER_ID	[none]
SOIL_DEPTH	[millimeters]
CH4_CONC	[parts per million]
REVISION_DATE	[DD-MON-YY]
CRTFCN_CODE	[none]

#### TF04\_SOIL\_CO2\_ISOTOPE

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
CHAMBER_ID	[none]
SOIL_DEPTH	[millimeters]
DEL_13C	[per mil]
DEL_18O	[per mil]
CO2_CONC	[parts per million]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]



**TF04\_SOIL\_CO2\_PROFILE**

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
CHAMBER_ID	[none]
SOIL_DEPTH	[millimeters]
CO2_CONC	[parts per million]
REVISION_DATE	[DD-MON-YY]
CRTFCN_CODE	[none]

**TF04\_SOIL\_TEMP\_MOIST**

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
CHAMBER_ID	[none]
AIR_TEMP	[degrees Celsius]
SOIL_TEMP_5CM	[degrees Celsius]
SOIL_TEMP_10CM	[degrees Celsius]
SOIL_TEMP_15CM	[degrees Celsius]
SOIL_WATER_CONTENT	[percent]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

**TF04\_SOIL\_WATER\_CHEM**

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
SOIL_DEPTH	[millimeters]
TOT_ORG_C_CONC	[milligrams][liter <sup>-1</sup> soil water]
TOT_INORG_C_CONC	[milligrams][liter <sup>-1</sup> soil water]
ACID_NEUTRALIZING_CAPACITY	[microequivalents][liter <sup>-1</sup> soil water]
ELECTRIC_CONDUCTIVITY	[siemens][meter <sup>-1</sup> ]
SODIUM_EQUIV	[microequivalents charge][liter <sup>-1</sup> soil water]
AMMONIUM_EQUIV	[microequivalents charge][liter <sup>-1</sup> soil water]
POTASSIUM_EQUIV	[microequivalents charge][liter <sup>-1</sup> soil water]
MAGNESIUM_EQUIV	[microequivalents charge][liter <sup>-1</sup> soil water]
CALCIUM_EQUIV	[microequivalents charge][liter <sup>-1</sup> soil water]
CHLORIDE_EQUIV	[microequivalents charge][liter <sup>-1</sup> soil water]
NITRATE_EQUIV	[microequivalents charge][liter <sup>-1</sup> soil water]
SULFATE_EQUIV	[microequivalents charge][liter <sup>-1</sup> soil water]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

### 7.3.4 Data Source

The source of the parameter values contained in the data files on the CD-ROM are:

#### TF04\_SOIL\_CARBON

Column Name	Data Source
SITE_NAME	[Assigned by BORIS Staff]
SUB_SITE	[Assigned by BORIS Staff]
DATE_OBS	[Investigator]
DEPTH_INTERVAL	[Investigator]
TOTAL_CARBON_CONTENT	[BY WEIGHT]
INORGANIC_CARBON_CONTENT	[BY WEIGHT]
REVISION_DATE	[Assigned by BORIS Staff]
CRTFCN_CODE	[Assigned by BORIS Staff]

#### TF04\_SOIL\_CH4\_PROFILE

Column Name	Data Source
SITE_NAME	[Assigned by BORIS Staff]
SUB_SITE	[Assigned by BORIS Staff]
DATE_OBS	[Investigator]
CHAMBER_ID	[Investigator]
SOIL_DEPTH	[Investigator]
CH4_CONC	[Gas Chromatograph]
REVISION_DATE	[Assigned by BORIS Staff]
CRTFCN_CODE	[Assigned by BORIS Staff]

#### TF04\_SOIL\_CO2\_ISOTOPE

Column Name	Data Source
SITE_NAME	[Assigned by BORIS Staff]
SUB_SITE	[Assigned by BORIS Staff]
DATE_OBS	[Investigator]
CHAMBER_ID	[Investigator]
SOIL_DEPTH	[Investigator]
DEL_13C	[mass spectrometry]
DEL_18O	[mass spectrometry]
CO2_CONC	[PP Systems model EGM IRGA]
REVISION_DATE	[Assigned by BORIS Staff]
CRTFCN_CODE	[Assigned by BORIS Staff]

#### TF04\_SOIL\_CO2\_PROFILE

Column Name	Data Source
SITE_NAME	[Assigned by BORIS Staff]
SUB_SITE	[Assigned by BORIS Staff]
DATE_OBS	[Investigator]
CHAMBER_ID	[Investigator]
SOIL_DEPTH	[Investigator]
CO2_CONC	[PP Systems model EGM IRGA]
REVISION_DATE	[Assigned by BORIS Staff]
CRTFCN_CODE	[Assigned by BORIS Staff]

**TF04\_SOIL\_TEMP\_MOIST**

Column Name	Data Source
SITE_NAME	[Assigned by BORIS Staff]
SUB_SITE	[Assigned by BORIS Staff]
DATE_OBS	[Investigator]
TIME_OBS	[INVESTIGATOR]
CHAMBER_ID	[Investigator]
AIR_TEMP	[Fluke model 51 K thermometer]
SOIL_TEMP_5CM	[Fluke model 51 K thermometer]
SOIL_TEMP_10CM	[Fluke model 51 K thermometer]
SOIL_TEMP_15CM	[Fluke model 51 K thermometer]
SOIL_WATER_CONTENT	[By weight]
REVISION_DATE	[Assigned by BORIS Staff]
CRTFCN_CODE	[Assigned by BORIS Staff]

**TF04\_SOIL\_WATER\_CHEM**

Column Name	Data Source
SITE_NAME	[Assigned by BORIS Staff]
SUB_SITE	[Assigned by BORIS Staff]
DATE_OBS	[Investigator]
SOIL_DEPTH	[Investigator]
TOT_ORG_C_CONC	[BY WEIGHT]
TOT_INORG_C_CONC	[BY WEIGHT]
ACID_NEUTRALIZING_CAPACITY	[PLEASE COMPLETE]
ELECTRIC_CONDUCTIVITY	[Conductivity meter]
SODIUM_EQUIV	[According to Fishman and Friedman (1985)]
AMMONIUM_EQUIV	[According to Fishman and Friedman (1985)]
POTASSIUM_EQUIV	[According to Fishman and Friedman (1985)]
MAGNESIUM_EQUIV	[According to Fishman and Friedman (1985)]
CALCIUM_EQUIV	[According to Fishman and Friedman (1985)]
CHLORIDE_EQUIV	[According to Fishman and Friedman (1985)]
NITRATE_EQUIV	[According to Fishman and Friedman (1985)]
SULFATE_EQUIV	[According to Fishman and Friedman (1985)]
REVISION_DATE	[Assigned by BORIS Staff]
CRTFCN_CODE	[Assigned by BORIS Staff]

**7.3.5 Data Range**

The following table gives information about the parameter values found in the data files on the CD-ROM.

**TF04\_SOIL\_CARBON**

	Minimum	Maximum	Missng	Unrel	Below	Data
Column Name	Data	Data	Data	Data	Detect	Not
	Value	Value	Value	Value	Limit	Clldtd
SITE_NAME	SSA-OJP-FLXTR	SSA-YJP-FLXTR	None	None	None	None
SUB_SITE	9TF04-SPR01	9TF04-SPR01	None	None	None	None
DATE_OBS	22-MAY-94	21-AUG-94	None	None	None	None
DEPTH_INTERVAL	0-0.02	9.14	None	None	None	None
TOTAL_CARBON_CONTENT	.0236	1.1932	-999	None	None	None
INORGANIC_CARBON_CONTENT	0	1.159	None	None	None	None

CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	12-NOV-98	12-NOV-98	None	None	None	None

#### TF04\_SOIL\_CH4\_PROFILE

	Minimum	Maximum	Missng	Unrel	Below	Data
	Data	Data	Data	Data	Detect	Not
Column Name	Value	Value	Value	Value	Limit	Cllctd
SITE_NAME	SSA-9JP-CLRCT	SSA-YJP-FLXTR	None	None	None	None
SUB_SITE	9TF04-SPR01	9TF04-SPR01	None	None	None	None
DATE_OBS	27-MAY-94	21-MAR-95	None	None	None	None
CHAMBER_ID	AB	YJP	None	None	None	None
SOIL_DEPTH	-6	0	None	None	None	None
CH4_CONC	.01	2.58	-999	-888	None	Blank
REVISION_DATE	12-NOV-98	12-NOV-98	None	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None

#### TF04\_SOIL\_CO2\_ISOTOPE

	Minimum	Maximum	Missng	Unrel	Below	Data
	Data	Data	Data	Data	Detect	Not
Column Name	Value	Value	Value	Value	Limit	Cllctd
SITE_NAME	SSA-YJP-FLXTR	SSA-YJP-FLXTR	None	None	None	None
SUB_SITE	9TF04-SPR01	9TF04-SPR01	None	None	None	None
DATE_OBS	23-AUG-94	23-AUG-94	None	None	None	None
CHAMBER_ID	AH 1	UZ 6	None	None	None	None
SOIL_DEPTH	-6	-.1	None	None	None	None
DEL_13C	-21.29	-10.1	None	None	None	None
DEL_18O	20.65	28.94	None	None	None	None
CO2_CONC	1941	5980	None	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE			None	None	None	Blank

#### TF04\_SOIL\_CO2\_PROFILE

	Minimum	Maximum	Missng	Unrel	Below	Data
	Data	Data	Data	Data	Detect	Not
Column Name	Value	Value	Value	Value	Limit	Cllctd
SITE_NAME	SSA-9JP-CLRCT	SSA-YJP-FLXTR	None	None	None	None
SUB_SITE	9TF04-SPR01	9TF04-SPR01	None	None	None	None
DATE_OBS	26-MAY-94	21-MAR-95	None	None	None	None
CHAMBER_ID	MN	YJP	None	None	None	None
SOIL_DEPTH	-6	0	None	None	None	None
CO2_CONC	359	21110	-999	None	None	None
REVISION_DATE	12-NOV-98	12-NOV-98	None	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None

**TF04\_SOIL\_TEMP\_MOIST**

	Minimum	Maximum	Missng	Unrel	Below	Data
	Data	Data	Data	Data	Detect	Not
Column Name	Value	Value	Value	Value	Limit	Cllctd
SITE_NAME	SSA-9JP-CLRCT	SSA-YJP-FLXTR	None	None	None	None
SUB_SITE	9TF04-SPR01	9TF04-SPR01	None	None	None	None
DATE_OBS	22-MAY-94	18-SEP-94	None	None	None	None
TIME_OBS	0	930	None	None	None	None
CHAMBER_ID	AB	WX	None	None	None	None
AIR_TEMP	2.4	35.1	-999	None	None	None
SOIL_TEMP_5CM	9.1	27.3	-999	None	None	None
SOIL_TEMP_10CM	8.3	21.4	-999	None	None	None
SOIL_TEMP_15CM	1.5	19.7	-999	None	None	None
SOIL_WATER_CONTENT	.89	24.58	-999	None	None	Blank
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	12-NOV-98	12-NOV-98	None	None	None	None

**TF04\_SOIL\_WATER\_CHEM**

	Minimum	Maximum	Missng	Unrel	Below	Data
	Data	Data	Data	Data	Detect	Not
Column Name	Value	Value	Value	Value	Limit	Cllctd
SITE_NAME	SSA-YJP-FLXTR	SSA-YJP-FLXTR	None	None	None	None
SUB_SITE	9TF04-SPR01	9TF04-SPR01	None	None	None	None
DATE_OBS	19-JUL-94	19-JUL-94	None	None	None	None
SOIL_DEPTH	-1	-.1	None	None	None	None
TOT_ORG_C_CONC	9.05	74	None	None	None	None
TOT_INORG_C_CONC	.94	15.65	-999	None	None	None
ACID_NEUTRALIZING_	421.15	2494.7	None	None	None	None
CAPACITY						
ELECTRIC_	58.3	238	None	None	None	None
CONDUCTIVITY						
SODIUM_EQUIV	21.018	36.233	None	None	None	None
AMMONIUM_EQUIV	.746	2.516	None	None	None	None
POTASSIUM_EQUIV	4.346	9.582	None	None	None	None
MAGNESIUM_EQUIV	18.843	67.865	None	None	None	None
CALCIUM_EQUIV	42.5	158.607	None	None	None	None
CHLORIDE_EQUIV	5.45	9.42	None	None	None	None
NITRATE_EQUIV	.88	1.24	None	None	None	None
SULFATE_EQUIV	4.28	14.12	None	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	10-NOV-98	10-NOV-98	None	None	None	None

Minimum Data Value -- The minimum value found in the column.

Maximum Data Value -- The maximum value found in the column.

Missng Data Value -- The value that indicates missing data. This is used to indicate that an attempt was made to determine the parameter value, but the attempt was unsuccessful.

Unrel Data Value -- The value that indicates unreliable data. This is used to indicate an attempt was made to determine the parameter value, but the value was deemed to be unreliable by the analysis personnel.

Below Detect Limit -- The value that indicates parameter values below the instruments detection limits. This is used to indicate that an attempt was made to determine the parameter value, but the analysis personnel determined that the parameter value was below the detection limit of the instrumentation.

Data Not Cllctd -- This value indicates that no attempt was made to determine the parameter value. This usually indicates that BORIS combined several similar but not identical data sets into the same data base table but this particular science team did not measure that parameter.

Blank -- Indicates that blank spaces are used to denote that type of value.

N/A -- Indicates that the value is not applicable to the respective column.

None -- Indicates that no values of that sort were found in the column.

-----

## 7.4 Sample Data Record

The following are wrapped versions of data record from a sample data file on the CD-ROM.

### TF04\_SOIL\_CARBON

```
SITE_NAME,SUB_SITE,DATE_OBS,DEPTH_INTERVAL,TOTAL_CARBON_CONTENT,
INORGANIC_CARBON_CONTENT,CRTFCN_CODE,REVISION_DATE
'SSA-OJP-FLXTR','9TF04-SPR01',22-MAY-94,'0-0.02',1.1932,.0094,'CPI',12-NOV-98
'SSA-OJP-FLXTR','9TF04-SPR01',22-MAY-94,'0-0.1',.3754,.004,'CPI',12-NOV-98
'SSA-OJP-FLXTR','9TF04-SPR01',22-MAY-94,'0.1-0.3',.0762,.0008,'CPI',12-NOV-98
'SSA-OJP-FLXTR','9TF04-SPR01',22-MAY-94,'0.3-0.6',.041,.0006,'CPI',12-NOV-98
```

### TF04\_SOIL\_CH4\_PROFILE

```
SITE_NAME,SUB_SITE,DATE_OBS,CHAMBER_ID,SOIL_DEPTH,CH4_CONC,REVISION_DATE,
CRTFCN_CODE
'SSA-9JP-CLRCT','9TF04-SPR01',05-JUN-94,'ST',0.0,-999.0,12-NOV-98,'CPI'
'SSA-9JP-CLRCT','9TF04-SPR01',05-JUN-94,'ST',-.1,1.56,12-NOV-98,'CPI'
```

### TF04\_SOIL\_CO2\_ISOTOPE

```
SITE_NAME,SUB_SITE,DATE_OBS,CHAMBER_ID,SOIL_DEPTH,DEL_13C,DEL_18O,CO2_CONC,
CRTFCN_CODE,REVISION_DATE
'SSA-YJP-FLXTR','9TF04-SPR01',23-AUG-94,'UZ 1',-1.0,-10.1,27.73,4232.0,'CPI',
10-NOV-98
'SSA-YJP-FLXTR','9TF04-SPR01',23-AUG-94,'UZ 2',-2.0,-20.41,20.68,4057.0,'CPI',
10-NOV-98
'SSA-YJP-FLXTR','9TF04-SPR01',23-AUG-94,'UZ 3',-3.0,-20.47,23.57,3547.0,'CPI',
10-NOV-98
```

### TF04\_SOIL\_CO2\_PROFILE

```
SITE_NAME,SUB_SITE,DATE_OBS,CHAMBER_ID,SOIL_DEPTH,CO2_CONC,REVISION_DATE,
CRTFCN_CODE
'SSA-9JP-CLRCT','9TF04-SPR01',05-JUN-94,'ST',0.0,-999.0,12-NOV-98,'CPI'
'SSA-9JP-CLRCT','9TF04-SPR01',05-JUN-94,'ST',-.1,570.0,12-NOV-98,'CPI'
'SSA-9JP-CLRCT','9TF04-SPR01',05-JUN-94,'ST',-.1,621.0,12-NOV-98,'CPI'
'SSA-9JP-CLRCT','9TF04-SPR01',05-JUN-94,'ST',-.2,-999.0,12-NOV-98,'CPI'
'SSA-9JP-CLRCT','9TF04-SPR01',05-JUN-94,'ST',-.2,826.0,12-NOV-98,'CPI'
```

#### **TF04\_SOIL\_TEMP\_MOIST**

SITE\_NAME, SUB\_SITE, DATE\_OBS, TIME\_OBS, CHAMBER\_ID, AIR\_TEMP, SOIL\_TEMP\_5CM,  
SOIL\_TEMP\_10CM, SOIL\_TEMP\_15CM, SOIL\_WATER\_CONTENT, CRTFCN\_CODE, REVISION\_DATE  
'SSA-9JP-CLRCT', '9TF04-SPR01', 26-MAY-94, 330, 'ST', -999.0, 16.5, 13.3, 11.3, 8.83,  
'CPI', 12-NOV-98  
'SSA-9JP-CLRCT', '9TF04-SPR01', 26-MAY-94, 330, 'UV', -999.0, 15.1, 13.7, 11.5, 11.91,  
'CPI', 12-NOV-98

#### **TF04\_SOIL\_WATER\_CHEM**

SITE\_NAME, SUB\_SITE, DATE\_OBS, SOIL\_DEPTH, TOT\_ORG\_C\_CONC, TOT\_INORG\_C\_CONC,  
ACID\_NEUTRALIZING\_CAPACITY, ELECTRIC\_CONDUCTIVITY, SODIUM\_EQUIV, AMMONIUM\_EQUIV,  
POTASSIUM\_EQUIV, MAGNESIUM\_EQUIV, CALCIUM\_EQUIV, CHLORIDE\_EQUIV, NITRATE\_EQUIV,  
SULFATE\_EQUIV, CRTFCN\_CODE, REVISION\_DATE  
'SSA-YJP-FLXTR', '9TF04-SPR01', 19-JUL-94, -.3, 74.0, .94, 421.15, 72.6, 24.014,  
2.516, 7.262, 19.751, 53.038, 5.45, .91, 5.79, 'CPI', 10-NOV-98  
'SSA-YJP-FLXTR', '9TF04-SPR01', 19-JUL-94, -.8, 36.58, 8.6, 1408.44, 158.1,  
21.018, .746, 4.346, 40.496, 107.1, 9.42, .88, 14.12, 'CPI', 10-NOV-98

## **8. Data Organization**

### **8.1 Data Granularity**

The smallest unit of data tracked by the BOREAS Information System (BORIS) is the measurement(s) made for a given site at a given time.

### **8.2 Data Format(s)**

The Compact Disk-Read-Only Memory (CD-ROM) files contain ASCII numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

## **9. Data Manipulations**

### **9.1 Formulae**

#### **9.1.1 Derivation Techniques and Algorithms**

None given.

### **9.2 Data Processing Sequence**

#### **9.2.1 Processing Steps**

None given

#### **9.2.2 Processing Changes**

None given.

### **9.3 Calculations**

#### **9.3.1 Special Corrections/Adjustments**

None given.

#### **9.3.2 Calculated Variables**

None.

### **9.4 Graphs and Plots**

None given.

## **10. Errors**

### **10.1 Sources of Error**

None given.

### **10.2 Quality Assessment**

#### **10.2.1 Data Validation by Source**

None given.

#### **10.2.2 Confidence Level/Accuracy Judgment**

None given.

#### **10.2.3 Measurement Error for Parameters**

None given.

#### **10.2.4 Additional Quality Assessments**

None given.

#### **10.2.5 Data Verification by Data Center**

Data were examined for general consistency and clarity.

## **11. Notes**

### **11.1 Limitations of the Data**

None given.

### **11.2 Known Problems with the Data**

See Section 10.1.

### **11.3 Usage Guidance**

See Section 10.1.

### **11.4 Other Relevant Information**

None given.

## **12. Application of the Data Set**

None given.



## **13. Future Modifications and Plans**

None given.

## **14. Software**

### **14.1 Software Description**

None given.

### **14.2 Software Access**

Not applicable.

## **15. Data Access**

The CO<sub>2</sub> and CH<sub>4</sub> soil profile data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

### **15.1 Contact Information**

For BOREAS data and documentation please contact:

ORNL DAAC User Services  
Oak Ridge National Laboratory  
P.O. Box 2008 MS-6407  
Oak Ridge, TN 37831-6407  
Phone: (423) 241-3952  
Fax: (423) 574-4665  
E-mail: [ornldaac@ornl.gov](mailto:ornldaac@ornl.gov) or [ornl@eos.nasa.gov](mailto:ornl@eos.nasa.gov)

### **15.2 Data Center Identification**

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics  
<http://www-eosdis.ornl.gov/>.

### **15.3 Procedures for Obtaining Data**

Users may obtain data directly through the ORNL DAAC online search and order system [<http://www-eosdis.ornl.gov/>] and the anonymous FTP site [<ftp://www-eosdis.ornl.gov/data/>] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

### **15.4 Data Center Status/Plans**

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

## **16. Output Products and Availability**

### **16.1 Tape Products**

None.

### **16.2 Film Products**

None.

### **16.3 Other Products**

These data are available on the BOREAS CD-ROM series.

## **17. References**

### **17.1 Platform/Sensor/Instrument/Data Processing Documentation**

Klute, A. (Ed.). 1986. Methods of Soil Analysis, Part I: Physical and Mineralogical Methods, Agronomy Monograph no. 9 (2nd Ed.) American Society of Agronomy. Madison, WI.

### **17.2 Journal Articles and Study Reports**

Fishman M.J. and L.C. Fiedman. 1985. Methods of determination of inorganic substances in water and fluvial sediments. Techniques of Water Resources Investigations of the U.S. Geological Survey. Book 5 Chapter A1, 5445 p.

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

Sellers, P. and F. Hall. 1994. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

Sellers, P. and F. Hall. 1996. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1996-2.0, NASA BOREAS Report (EXPLAN 96).

Sellers, P., F. Hall, and K.F. Huemmrich. 1996. Boreal Ecosystem-Atmosphere Study: 1994 Operations. NASA BOREAS Report (OPS DOC 94).

Sellers, P., F. Hall, and K.F. Huemmrich. 1997. Boreal Ecosystem-Atmosphere Study: 1996 Operations. NASA BOREAS Report (OPS DOC 96).

Sellers, P., F. Hall, H. Margolis, B. Kelly, D. Baldocchi, G. den Hartog, J. Cihlar, M.G. Ryan, B. Goodison, P. Crill, K.J. Ranson, D. Lettenmaier, and D.E. Wickland. 1995. The boreal ecosystem-atmosphere study (BOREAS): an overview and early results from the 1994 field year. Bulletin of the American Meteorological Society. 76(9):1549-1577.

Sellers, P.J., F.G. Hall, R.D. Kelly, A. Black, D. Baldocchi, J. Berry, M. Ryan, K.J. Ranson, P.M. Crill, D.P. Lettenmaier, H. Margolis, J. Cihlar, J. Newcomer, D. Fitzjarrald, P.G. Jarvis, S.T. Gower, D. Halliwell, D. Williams, B. Goodison, D.E. Wickland, and F.E. Guertin. 1997. BOREAS in 1997: Experiment Overview, Scientific Results and Future Directions. Journal of Geophysical Research 102(D24): 28,731-28,770.

Striegl, R.G. and K.P. Wickland. 1998. Effects of a clear-cut harvest on soil respiration in a jack-pine lichen woodland. Can. Jour. Forest Research 28:534-539.

Wickland, K.P. and R.G. Striegl. 1997. Measurements of soil carbon dioxide and methane concentrations and fluxes, and soil properties at four ages of jack pine forest in the Southern Study Area of the Boreal Ecosystem Atmosphere Study, Saskatchewan, Canada, 1993-1995. U.S. Geological Survey Open-File Report. 97-49.

### **17.3 Archive/DBMS Usage Documentation**

None.

## **18. Glossary of Terms**

None.

## **19. List of Acronyms**

ASCII	- American Standard Code for Information Interchange
BOREAS	- BOReal Ecosystem-Atmosphere Study
BORIS	- BOREAS Information System
CC	- Clear Cut site
CD-ROM	- Compact Disk-Read-Only Memory
DAAC	- Distributed Active Archive Center
EOS	- Earth Observing System
EOSDIS	- EOS Data and Information System
GIS	- Geographic Information System
GMT	- Greenwich Mean Time
GSFC	- Goddard Space Flight Center
HTML	- HyperText Markup Language
IRGA	- Infrared Gas Analyzer
NAD83	- North American Datum of 1983
NASA	- National Aeronautics and Space Administration
NSA	- Northern Study Area
OBS	- Old Black Spruce
OJP	- Old Jack Pine
ORNL	- Oak Ridge National Laboratory
PANP	- Prince Albert National Park
PPFD	- Photosynthetically Active Photon Flux Density
RC	- Recently Cut site
SSA	- Southern Study Area
TF	- Tower Flux
TGB	- Trace Gas Biochemistry
URL	- Uniform Resource Locator
YJP	- Young Jack Pine

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Striegl, R.G. and K.P. Wickland. 1998. effects of a clear-cut harvest on soil respiration in a jack-pine lichen woodland, Can. Jour. Forest Research 28:534-539.

Fishman M.J. and L.C. Fiedman. 1985. Methods of determination of inorganic substances in water and fluvial sediments. Techniques of Water Resources Investigations of the U.S. Geological Survey. Book 5 Chapter A1, 5445 p.

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